UNIT 1 OBJECTIVES

I Can…

✓		
	TK1	state why physics is the most basic of all sciences.
	TK2	describe how math is the language of science.
	TK3	describe the 5 steps of the scientific method. Describe an example of an experiment that employs these steps.
	TK4	define each of the following: fact, law, principle, theory.
	TK5	describe the requirements for a hypothesis to be scientific.
	TK6	state from memory the **prefix**, **symbol**, and **power-of-ten** (POT) for the following (see page 18 text): **milli**-, **centi**-, **kilo**-, **mega.**
	TK7	Convert physical quantities from one metric unit to another (ex: meters to kilometers).
	TK8	construct graphs from data, choosing suitable scales for the axes. Identify the **Independent Variable** and the **Dependent Variable**. Also fit appropriate lines or curves to the data.

UNIT 2 OBJECTIVES

✓		
	K1	Define that a **rate** is a quantity divided by a **time interval**.
	K2	Distinguish between **average speed** and **instantaneous speed**.
	K3	Calculate the **average speed** of an object (given **distance** and **time interval**) and express the result with appropriate **speed units**.
	K4	Distinguish between **speed** and **velocity**.
	K5	Tell when an object's **velocity** is changing. Describe a situation where an object's **velocity** is changing, but its **speed** is not.
	K6	Tell what **acceleration** is, and recognize when an **acceleration** occurs.
	K7	Distinguish between **velocity** and **acceleration**.
	K8	Calculate the **acceleration** of an object (given change in **velocity** and **time interval**) and recognize appropriate **acceleration units**.
	K9	Solve numerical problems involving objects having **constant velocity**.
	K10	Solve numerical problems involving objects having **constant acceleration**.
	K11	State the **acceleration** of an object in **free fall** near the earth's surface in metric and "customary" units.
	K12	State the value for the **acceleration** of an object in **free fall**.
	K13	Calculate the **velocity** (**instantaneous** or **average**) of an object in **free fall**, given the **time** of fall.
	K14	Calculate the **distance** traveled for an object in **free fall**, given the **time** of fall.

Unit 3 Objectives

I Can…

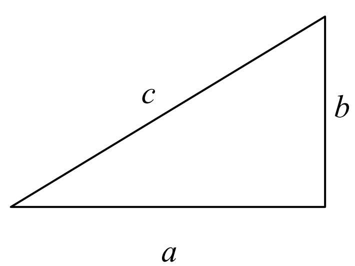
	V1	Distinguish between a vector quantity and a scalar quantity, and give examples of each (3.1)
	V2	Draw vector diagrams for velocities and use the parallelogram method to find the resultant of two vectors that have different directions (3.2)
	V3	Given a vector, resolve it into horizontal and vertical components (3.3)
	V4	For a projectile, describe the changes in the horizontal and vertical components of its velocity, when air resistance is negligible (3.4)
	V5	Explain why a projectile moves equal distances horizontally in equal time intervals, when air resistance is negligible (3.5)

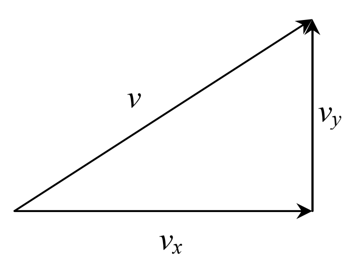
Vocabulary:

component
nonlinear motion
parabola
projectile
resolution
quantity
resultant
scalar quantity
vector
vector quantity
Pythagorean Theorem
parallelogram
perpendicular
parallel
displacement
x component
y component
hypotenuse
adjacent
opposite

Formulas: Pythagorean Theorem: $c^2 = a^2 + b^2$ or hyp^2 = adj^2 + opp^2

$v^2 = v_x^2 + v_y^2$





NEWTON'S LAWS OBJECTIVES CHECKLIST

I can…

✓	
	Define Newton's First Law, and explain the two types of equilibrium (static and dynamic).
	Given a situation, draw a clearly labeled force diagram illustrating the forces acting on an object, including a frame of reference. \
	Know how friction affects motion, and apply and use it in a force diagram. State Newton's Second Law of Motion.
	Calculate the Net Force acting on an object.
	Solve problems involving Newton's First and/or Second laws with the use a of a force diagram and "ΣF" equations.
	State Newton's Third Law of motion.
	Recognize and/or give examples of action/reaction force pairs.
	Explain why equal-and-opposite forces obeying Newton's First Law differ from equal-and-opposite forces obeying Newton's Third Law.
	Describe how an object's inertia affects its motion
	Describe how net external force affects the motion of an object.
	Solve problems involving multiple forces, using free-body diagrams.
	Explain the difference between mass and weight.
	Find the direction and magnitude of normal forces.
	Describe air resistance as a form of friction.
	Predict the motion of a body when friction is a factor.

(Continued on back)

I will know:

✓	
	Inertia is the resistance of a body to a change in its motion, and is directly related to its mass
	Newton's three laws of motion are the basis for understanding the mechanical universe.
	An object with no net force acting on it moves with constant velocity.
	The acceleration of a body is directly proportional to the net force on it and inversely proportional to its mass.
	When one object exerts a force on a second object, the second exerts a force on the first that is equal in magnitude but opposite in direction.
	Equal and opposite forces that act on the same object will cancel; Equal and opposite forces that act on different objects will not cancel.
	Weight is the gravitational force acting on a body.
	Friction is a force that acts in a direction opposite the velocity.
	Static friction opposes the start of motion; Kinetic friction opposes the continuation of motion.

CIRCULAR MOTION/GRAVITATION OBJECTIVES

I Can…

	Identify the direction of the velocity, net force, and acceleration of an object moving with uniform circular motion.
	Explain how an object can have acceleration even though its speed is constant.
	Recognize, both graphically and mathematically, the proportion between the speed and net centripetal force acting on an object in uniform circular motion and use that proportion to determine the effect of changing speed on net centripetal force.
	Explain why a person moving in a circular path feels pushed/pulled away from the center.
	Solve mathematical problems involving speed, centripetal acceleration and net centripetal force, including horizontal and vertical motion problems.
	Solve mathematical problems involving the force of gravity between two masses and the distance between them.
	Determine the effect of changing masses on the force of gravity between two objects.
	Determine the effect of changing distance on the force of gravity between two masses.
	Derive the equation for the acceleration due to gravity.
	Derive the equation for the speed of a perfectly circular orbit.
	Solve mathematical problems involving orbital motion.

Work and Energy Objectives

1. Describe the relationship between work and energy.
2. Calculate work done by a force.
3. Identify forces that do work and forces that don't do work, and explain your reasoning.
4. Differentiate between work and power and correctly calculate power expended.
5. Explain why simple machines are useful. Identify whether machines can multiply force and/or work.
6. Communicate an understanding of mechanical advantage (Ideal and Actual) in simple machines.
7. Calculate efficiencies and mechanical advantages for simple machines.
8. Apply the Work-Energy Theorum to solve problems.
9. Calculate the kinetic energy of a moving object.
10. Determine how to find the gravitational potential energy of a system.
11. Solve problems and/or identify situations where energy is conserved.

IMPULSE/MOMENTUM OBJECTIVES

I Can…

☐	define **impulse** and **momentum** and explain how they are related.
☐	state the **units** for **impulse** and **momentum**.
☐	calculate the **impulse** on an object, given the **net force** acting on it and the **time** in which it acts.
☐	calculate the **momentum** of an object given its **mass** and **velocity**.
☐	give or discuss real-life examples of how **changing the momentum** of an object is affected by the type of **impulse** applied (large **force** over a small **time**, small **force** over a large **time**, etc.)
☐	explain why a greater **impulse** acts on an object that **bounces** during a **collision** as opposed to an object that simply comes to a stop, and explain what effect this extra **impulse** has on the object.
☐	state the **Law of Conservation of Momentum**.
☐	distinguish between **elastic** and **inelastic collisions**.
☐	use the **Law of Conservation of Momentum** to calculate the **velocity** of an object undergoing a simple **inelastic collision**.
☐	use the **Law of Conservation of Momentum** to calculate the **velocity** of an object undergoing a simple **elastic collision**.

SHM & WAVES: OBJECTIVES CHECKLIST

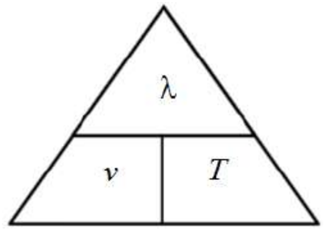
I can…

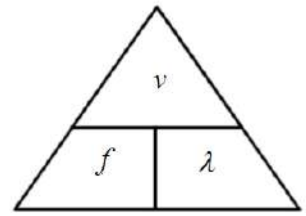
✓	
	Define: **Period**, **vibration**, **wave**.
	For a **pendulum**, identify what factors affect its period, and what constitutes a single vibration of a pendulum.
	Define **Simple Harmonic Motion (SHM)**.
	Given a sine curve depiction of a wave, identify and define the following: **Crest**; **Trough; Amplitude; Wavelength**.
	Define **frequency**.
	State the units of frequency, period, and wavelength.
	State the **relationship** between **period** and **frequency**.
	Describe how **wave speed**, **frequency** and **wavelength** are related, and calculate one, given the other two values.
	Define and give an example of: **transverse wave**, **longitudinal wave**.
	Define and give examples of: **Constructive interference**, **Destructive interference**.
	Describe how a **standing wave** works and give examples.
	Define and/or identify: **node**, **antinode**.
	Describe how the **Doppler Effect** works.
	Describe how a **Shock Wave** or **Sonic Boom** is formed.

SHM & WAVES: VOCABULARY & EQUATIONS

f	frequency	Hz
T	period	s
v	wave speed	m/s
λ	wavelength	m

$f = \frac{1}{T}$ or $T = \frac{1}{f}$





SHM & WAVES: VOCABULARY

SHM	WAVE BASICS	WAVE PHENOMENA	STANDING WAVES
stiffness mass restoring force amplitude equilibrium position	amplitude compression crest frequency hertz longitudinal wave mechanical wave period periodic wave rarefaction sound wave transverse wave trough wave pulse wavelength	constructive interference destructive interference Doppler shift in phase superposition reflected wave resonance out of phase	all harmonics antinodes even harmonics nodes odd harmonics fundamental frequency harmonics

TORQUE OBJECTIVES

I Can…

- ☐ ...in order to demonstrate mastery of the concept of torque,
  - ☐ Distinguish between torque and force.
  - ☐ Calculate the magnitude and direction of the torque associated with a given force.
- ☐ Define and describe examples of the three classes of levers.
- ☐ ...while analyzing problems in statics,
  - ☐ State the conditions for translational and rotational equilibrium of a rigid object.
  - ☐ Apply these conditions in analyzing the equilibrium of a rigid object under the combined influence of a number of coplanar forces applied at different locations.

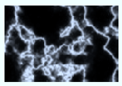
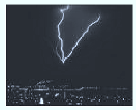
Electrostatics Objectives - Chapter 17

1. State the different types of electric charge and the magnitude of the smallest available charge.
2. Describe the process by which an object becomes electrically charged through conduction.
3. Describe the process by which an object becomes electrically charged through conduction.
4. Describe the process of grounding.
5. Compare the difference between insulators and conductors.
6. Be able to use coulomb's law and apply it to situations involving one or multiple charges.
7. Definition and describe the behavior of charges in an electric field.
8. Be able to sketch electric field lines for simple charge distributions.

$F = \frac{kq_1q_2}{d^2}$	Force between two charges equals electrostatic constant times magnitude of first charge times magnitude of second charge divided by the square of the separation distance
k	Electrostatic Constant $9\times10^9\ \frac{N\cdot m^2}{C^2}$
$E = \frac{F}{q_2}$	Electric Field equals Electric Force divided by charge placed in the field
$E = \frac{kq_1}{d^2}$	Electric Field at a certain point due to a point charge "q_1"equals electrostatic constant times charge divided by the square of the distance to the point
$V = Ed$	Potential Difference (or Voltage) between two parallel plates equals Electric field between plates times separation distance between plates
$V = \frac{kq_1}{d}$	Potential at a point due to a point charge "q_1" equals electrostatic constant times charge divided by distance from the charge to the point
$C = \frac{Q}{V}$	Capacitance equals Charge (on one plate of the capacitor) divided by voltage (potential difference) between the plates)
$W = qV$	Work Done to move a charge through a Potential Difference equals the Potential difference times the quantity of charge being moved

SYMBOL	NAME	UNIT	UNIT SYMBOL	HOW DO YOU FIND IT?
F	Force	Newton	Nt	$F = \frac{kq_1q_2}{d^2}$ or $F = q_2E$
q or Q	(quantity of) charge	Coulomb	C	Solve $F = \frac{kq_1q_2}{d^2}$ for q or $Q = CV$ (for a capacitor)
d	(separation) distance	meters	M	Solve $F = \frac{kq_1q_2}{d^2}$ for d or $V = Ed$ for d
E	Electric Field (Intensity)	Newtons per Coulomb or Volts per meter	Nt/C or V/m	$E = \frac{F}{q_2}$ or $E = \frac{kq_1}{d^2}$ or $E = \frac{V}{d}$
V	Potential Difference or Voltage	Volts	N/C	$V = \frac{kq_1}{d}$ or solve $W = qV$ or $Q = CV$ for V

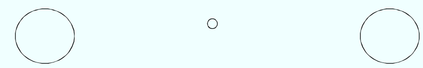
Static Electricity

Static Electricity

All objects contain electrical charges. These charges come from three subatomic particles:

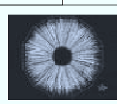
Protons Electrons Neutrons



Static Electricity

Characteristics of subatomic particles:

Particle	Charge	Mass	Location
Proton	positive	1 amu	nucleus
Electron	negative	.0005	orbits
Neutron	neutral	1 amu	nucleus



Static Electricity

Charge is measured in **Coulombs**.

Proton $+ 1.60 \times 10^{-19}$ C

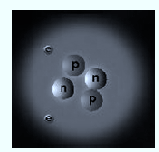
Electron $- 1.60 \times 10^{-19}$ C

Mass is measured in **kilograms**.

Proton 1.673×10^{-27} kg

Electron 9.109×10^{-31} kg

Neutron 1.675×10^{-27} kg



Static Electricity

Objects containing more of one type of charge than another are <u>electrically charged</u>.

Positively charged objects have more protons than electrons (a deficiency of electrons).

Remove electrons - positive charge

Add electrons - negative charge

Static Electricity

CAUTION!!!!

Objects are charged by adding or removing ELECTRONS ONLY!!!!

Adding or removing protons changes the identity of the substance – and requires more energy than you could generate in the classroom!!!!!

Static Electricity

First Law of Electrostatics:

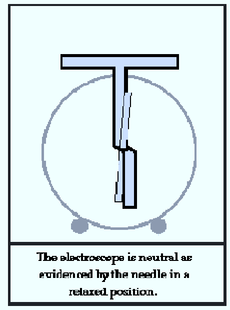
Like Charges Repel Each Other

Unlike Charges Attract Each Other

Electroscopes are used to demonstrate the separation of charges.

Static Electricity

Here's How It Works:



To clarify – the positive charge doesn't actually move – there are still electrons left which shift around after the balloon is removed

Static Electricity

The Law of Conservation of Charge

Charge can neither be created nor destroyed. It can only be *transferred*.

Static Electricity

Conductors:

Permit the flow of electric charge from one atom to the next.

The charges that flow are *electrons*.

Static Electricity

Conductors:

Electrons in the outer quantum levels are free to "roam" from atom to atom.

Most metals are good conductors.

Static Electricity

Insulators:

Prevent or restrict the flow of electrical charge.

Insulators can hold a charge, but only a small area remains charged.

Static Electricity

Insulators:

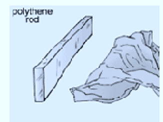
Electrons are bound to specific atoms in shared covalent bonds.

Glass, dry wood, plastic, cloth, and dry air make good insulators.

Static Electricity

Separation of charge:

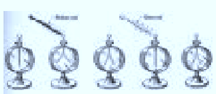
Friction between two insulators causes heat that separates electrons from their atoms.



Static Electricity

Charging by Conduction:

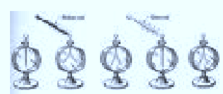
Charge can be transferred when two objects are brought in contact with each other.



Static Electricity

Charging by Conduction:

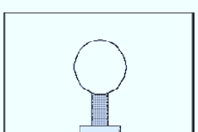
When the object touch, there is a transfer of charge and the objects have the same charge.



Static Electricity

Charging by Induction:

Charge can be induced when two objects are brought near each other. Grounding the object induces the opposite charge.



A negatively charged object is brought near to a neutral, conducting sphere. Electrons in the sphere are forced from the left side of the sphere to the right side.

Static Electricity

Electric forces:

- exerted at a distance
- directly proportional to charge
- inversely proportional to distance

Coulomb's Law

$$F = \frac{kq_1q_2}{d^2}$$

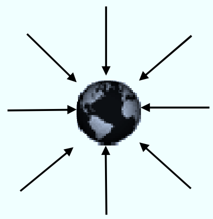
$k = 9 \times 10^9\ Nt \bullet m^2 / C^2$

Gravitational Fields

A gravitational field exists in the area of space generated the Earth's mass. It is not tangible, but it has a tangible effect on an object placed in the field of the Earth's gravity.

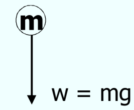
$$F_{grav} = \frac{Gm_1m_2}{d^2}$$

$G = 6.67 \times 10^{-11}$ Ntm^2 / kg^2



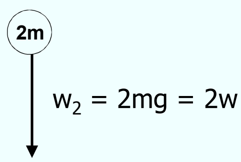
Electric Fields

Imagine a mass placed at a certain point in Earth's gravitational field…



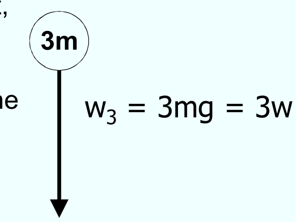
Electric Fields

Increase the amount of mass at that point, and the gravitational force also increases…



Electric Fields

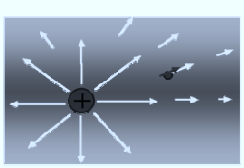
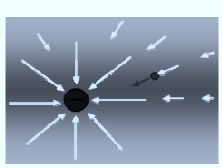
The strength of the field at this point remains constant, but the force it exerts increases with the size of the mass placed at that point.



Electric Fields

An electric field surrounds any object that has a non-zero charge.

The direction of the electric field is determined by a positive test charge.

Electric Fields

The direction of the electric field is away from the positive charge and toward the negative charge.

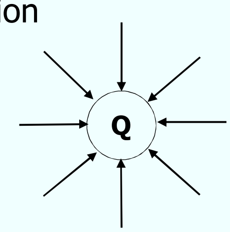
Electric field lines verify that like charges repel each other and unlike charges attract each other. Through their interactions with a "+" charge

Electric Fields

Electric fields are vector quantities:

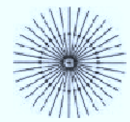
Magnitude

Direction



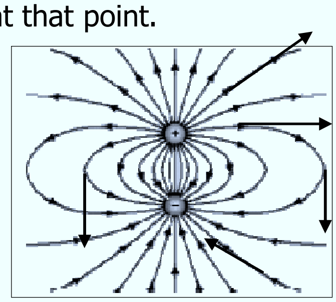
Electric Fields

The direction of the field at any point is in the same direction as the force experienced by a positive test charge placed at that point.



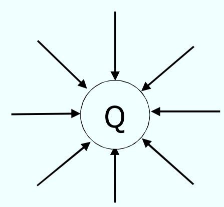
Electric Fields

The field lines show the direction of a force on a positive test charge placed at that point.



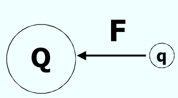
Electric Fields

An electric charge Q sets up an electric field in the space surrounding it.



Electric Fields

A second (positive) charge q placed near Q experiences a force due to the field generated by charge Q.

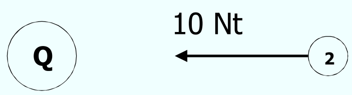


Electric Fields

A field strength of 5.00 N/C at a given points means that a point charge q of 1.00 C placed at this point would experience a force of 5 Nt because of the electric field of Q.

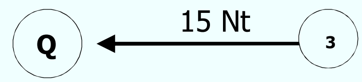
Electric Fields

2.00 Coulombs ➔ 10.0 Nt



Electric Fields

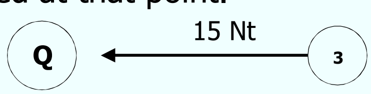
3.00 Coulombs ➔ 15.0 Nt



Think of a mass you hold – the bigger the mass, the bigger its weight – the strength of the gravitational field it's in doesn't change, but its pull on the mass *does*.

Electric Fields

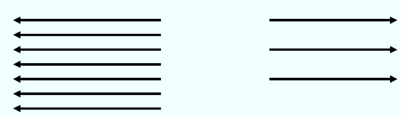
The magnitude of the electric field at a certain point is constant. The *Force* exerted on a charge by the field depends on the size of the charge located at that point.



Electric Fields

Electric field lines - rules:

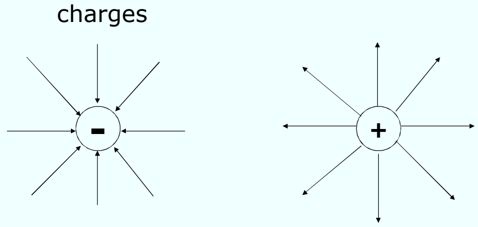
- Electric field lines never cross each other.
- Closely spaced lines indicate a strong field.
- Lines spaced far apart indicate a weak field.



Electric Fields

Electric field lines - rules:

- Field lines point toward negative charges
- Field lines point away from positive charges

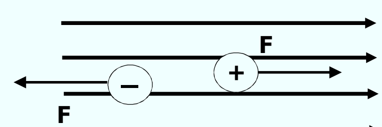


Electric Fields

Electric field lines - rules:

When a positive charge is placed in an electric field,…

…the direction of the electrical force on that charge is the same as the electrical field,…



When a negative charge is placed in an electric field, the force is opposite to the field.

Methods For Working Coulomb's Law Problems

Coulomb's Law calculates the **magnitude** of the electric force between two charged objects, when the charges are known. The direction of the force is always along a line joining the two objects. If the two objects have the same sign, the force on either object is repulsive. If the two objects have opposite signs, the force on either object is attractive.

Since charges are small, they are usually expressed in non-SI units of microcoulombs, nanocoulombs, or picocoulombs. They must be converted into Coulombs for calculations.

$$1\ \mu C = 1 \times 10^{-6} C$$
$$1\ nC = 1 \times 10^{-9}\ C$$
$$1\ pC = 1 \times 10^{-12} C$$

1. Always remember to **convert** everything to **SI units**! A microcoulomb (μC) is <u>not</u> an SI unit. It must be converted into Coulombs. Remember to **convert** distances in centimeters to **meters**.

2. **Forces** are **vector** quantities. We will use Coulomb's law to calculate the magnitude of the electrostatic force between two charges. When we are calculating magnitude, we will **not** consider the signs of the charges.

3. Because forces are vector quantities, we will use free body diagrams to determine the direction of the electrostatic force between two charges.

Determine the magnitude and direction of the electrostatic force exerted by a +5 μC charge on a +4 μC charge 20 cm away. Is it repulsive or attractive?

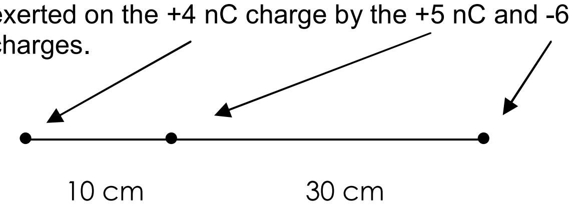
Givens: $q_1 = 5\text{x}10^{-6}$ C $q_2 = 4\text{x}10^{-6}$ C $k = 9\text{x}10^{9} \frac{N \cdot m^2}{C^2}$

$r = 20$ cm = .20 m

$$F = \frac{kq_1q_2}{d^2} = \frac{(9x10^9 \frac{N \cdot m^2}{C^2})(5x10^{-6}C)(4x10^{-6}C)}{(0.20m)^2} = 4.5 \text{ N}$$

Since they are like charges, the force is **repulsive**

Determine the magnitude and direction of the force exerted on the +4 nC charge by the +5 nC and -6 nC charges.



$$F_{54} = \frac{kq_1q_2}{d^2} = \frac{(9x10^9 \frac{N \cdot m^2}{C^2})(5x10^{-9}C)(4x10^{-9}C)}{(0.10m)^2}$$

$= -1.8\text{x}10^{-5}$ N

the +5nC charge repels the +4 nC charge to the left, thus the negative sign.

$$F_{64} = \frac{kq_1q_2}{d^2} = \frac{(9x10^9 \frac{N \cdot m^2}{C^2})(6x10^{-9}C)(4x10^{-9}C)}{(0.40m)^2}$$

$= +1.35\ \text{x}10^{-6}$ N

the -6 nC charge attracts the +4 nC charge to the right, thus the positive sign.

Net force = $+1.35\ \text{x}10^{-6}$ N $-1.8\text{x}10^{-5}$ N = $-1.665\ \text{x}10^{-5}$ N

Or $1.665\ \text{x}10^{-5}$ N **TO THE LEFT**

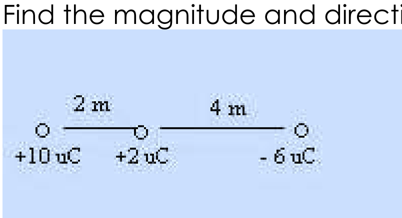
Coulomb's Law Practice

1. Two spheres separated by 0.06 m carry charges of +50 μC each. Calculate the force between them. What type of force is it? Ans: 6250N, repulsive

2. Two identical charges exert a force of +0.224 N when they are 50 cm apart. What is their magnitude? Ans: 2.49 μC

3. When a sphere carrying an unknown charge is placed 10 cm from a similar sphere carrying a charge of +2 μC, a 0.27 N, attractive, force is observed. Calculate the magnitude and sign of the unknown charge. Ans: -0.15 μC

4. Find the magnitude and direction of the resultant force on the +2 μC charge. Ans: 0.052 N, right

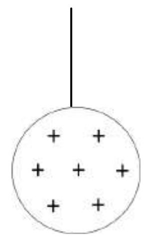
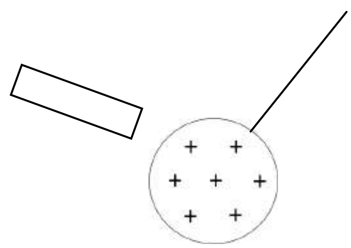
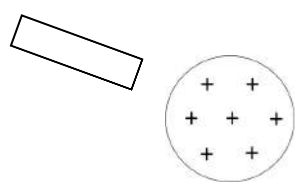
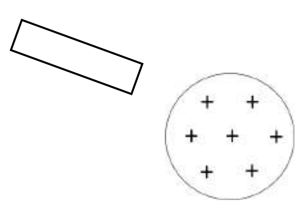


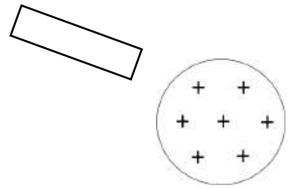
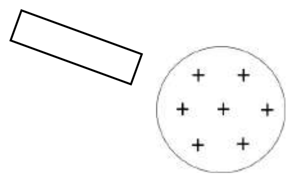
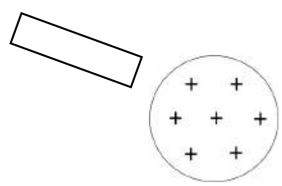
5. Find the resultant force on the -6 μC charge in number four. Ans: 0.022 N, left

6. Find the resultant force on the +10 μC charge in number four. Ans: 0.030 N, left

ELECTROSTATICS ACTIVITY

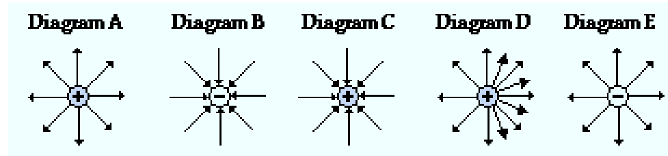
For reference, you can go to the file "pithBallS.dcr" in the Chapter 17 folder on the R drive, right click on it and open it with Internet Explorer. Or go to http://physics.weber.edu/amiri/director/dcrfiles/electricity/pithBallS.dcr. Please note the incorrect representation of positive charge movement. Positive charge **NEVER** moves!!

MATERIALS	INSTRUCTION	DIAGRAM	EXPLANATION
Pith Ball	Complete the diagram to show the charge distribution on a neutral pith ball		Equal amounts of positive and negative charge are evenly distributed on an electrically neutral object.
Pith Ball Black Wool White Plastic Strip	Rub the White Plastic Strip with the Black Wool and bring it near the Pith Ball without touching (you draw the charge distribution in the rod and ball, and draw the pith ball string) (see also **11attneut.mov**)		The negatively charged strip repels electrons to the far side of the ball, and attracts the now-positive side of the pith ball
Pith Ball Black Wool White Plastic Strip	The White Plastic Strip touches the Pith Ball and is removed (you draw the charge distribution in the strip and ball, and draw the pith ball string)		
Pith Ball White Cloth Clear Plastic Strip	Touch the pith Ball to the metal stand to ground it. Rub the Clear Plastic Strip with the White Cloth and bring it near the Pith Ball without touching (you draw the charge distribution in the Cylinder and ball, and draw the pith ball string) (see also**11attneut.mov** and **17att-ind.swf**)		

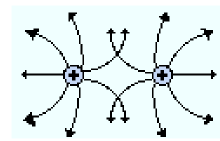
MATERIALS	INSTRUCTION	DIAGRAM	EXPLANATION
Pith Ball White Cloth Clear Plastic Strip	The Clear Plastic Strip touches the Pith Ball and is removed (you draw the charge distribution in the Cylinder and ball, and draw the pith ball string)		
Pith Ball (Charged) Black Wool White Plastic Strip	DO NOT GROUND THE PITH BALL. Rub the White Plastic Strip with the Black Wool and bring it near the Pith Ball without touching (you draw the charge distribution in the strip and ball, and draw the pith ball string)		
Pith Ball Black Wool White Plastic Strip	The White Plastic Strip touches the Pith Ball and is kept near. (you draw the charge distribution in the strip and ball, and draw the pith ball string)		
Videos: **01pos2pith.mov** **02neg2pith.mov** **03oop2pith.mov**	How do like and unlike charges interact with each other?		
Video: **09pickpap.mov**	When you charged either strip, did the entire rod become charged, or just the part you rubbed? What's your evidence?		

TEST YOUR KNOWLEDGE OF ELECTRIC FIELDS

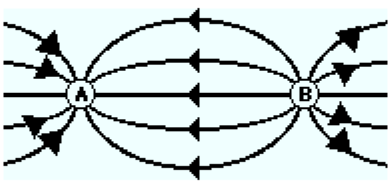
1. Several electric field line patterns are shown in the diagrams. Circle the incorrect patterns, and explain what is wrong with each one.



2. Erin drew the following electric field lines for a configuration of two charges. Name one thing Erin did right and one thing Erin did wrong.

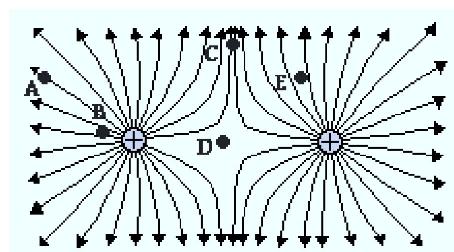


3. Consider the electric field lines shown in the diagram below. From the diagram, it is apparent that object A is ____ and object B is ____.



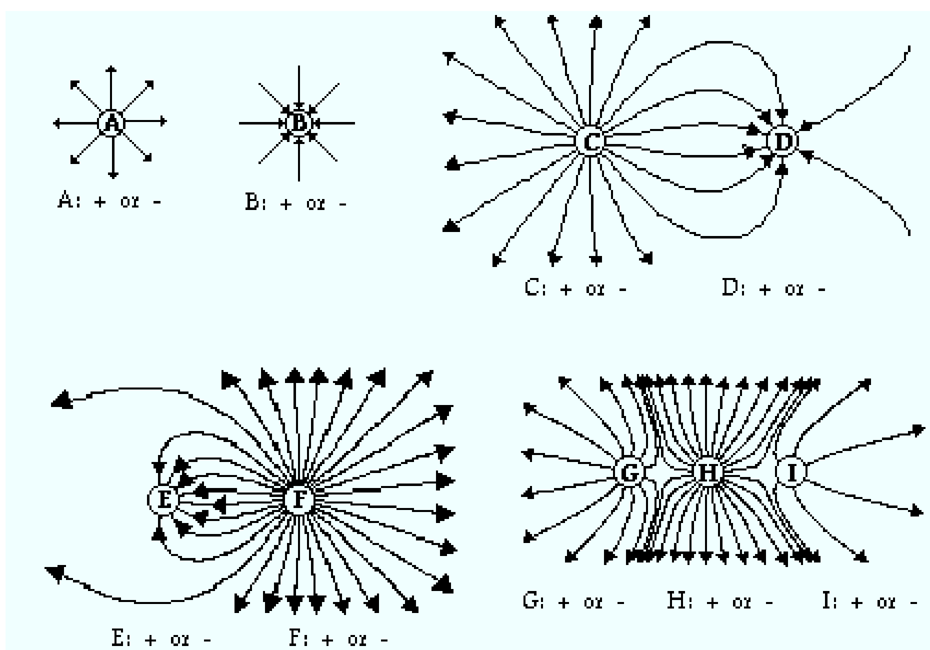
a. +, +   b. -, -   c. +, -   d. -, +   e. insufficient info

4. Consider the electric field lines drawn at the right for a configuration of two charges. Several locations are labeled on the diagram. Rank these locations in order of the electric field strength - from smallest to largest.
smallest 1._____ 2._____ 3._____ 4._____ 5._____ LARGEST



5. Use your understanding of electric field lines to identify the charges on the objects in the following configurations:

Additionally, for the last three diagrams, rank the charges from smallest to largest for each diagram.



Electric Field Practice

1. A test charge of -2×10^{-8} C experiences a force of 0.06 N when placed in an electric field. What is the electric field intensity? If the test charge has mass of 5×10^{-22} kg, what acceleration does it experience due to this force? Ans: 3×10^{6}N/C; 1.2×10^{20} m/s^{s}

2. A test charge of $+5 \times 10^{-4}$ C is in an electric field which exerts a force of 2.5×10^{-4}N upon it. What is the strength of the electric field? Ans: 0.5 N/C

3. A test charge of +80 μC is placed in a 50 N/C field. What force does it experience? Ans: 0.004 N

4. A +4.9 μC charge produces an electric field of 3.6×10^{4} N/C upon a positive test charge. How far away is the charge? Ans: 1.11 m

5. A 19 μC charged sphere produces a 1.7×10^{3} N/C upon a 0.5 μC test charge. What force is the charge subjected to? How far away is the test charge from the sphere? Ans: 0.00085 N; 10.03 m

Circuits Objectives

I Can…

✓	
	Describe the basic properties of electric current.
	Calculate resistance, current, and potential difference by using Ohm's Law.
	Relate electric power to the rate at which electrical energy is converted to other forms of energy.
	Calculate electric power and the cost of running electrical appliances.
	Interpret and construct simple circuit diagrams.
	Identify circuits as open or closed.
	Deduce the potential difference across the circuit load, given the potential difference across the battery's terminals.
	Calculate the equivalent (or total) resistance for a circuit of resistors in series, and find the current in and potential difference across each resistor in the circuit.
	Calculate the equivalent (or total) resistance for a circuit of resistors in parallel, and find the current in and potential difference across each resistor in the circuit.\
	Assemble simple circuits composed of batteries and resistors in series and in parallel.